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Life Cycle Metrics and OSD Oversight: Discipline With Flexibility

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Recognizing that systems were not achieving adequate reliability during development, leading to reduced warfighting capability and tremendous cost growth, the Joint Requirements Oversight Council acted in August 2006 to require a mandatory sustainment key performance parameter, materiel availability, and two supporting key system attributes, materiel reliability and ownership cost, for all new major defense acquisition programs and other selected programs. This article summarizes the background and rationale for the metrics and discusses some of the additional actions being taken to implement a disciplined approach to reliability and availability.

Key words: Availability; cost of ownership; maintainability; operations; reliability; support.

Whether the symptoms are presented as quality problems, or shortcomings in system reliability as cited in recent Government Accountability Office reports, or as an alarming trend in systems being found unsuitable during operational test and evaluation, it has become clear that the discipline necessary to field reliable, high quality systems needs to be strengthened throughout the Department of Defense (DOD) acquisition system. DOD and Military Service policies continue to stress the importance of reliability, availability, maintainability, and quality, and there is no shortage of reference materials, guides, training, and tools available to support the practitioner, yet there is a systemic shortfall in implementing the best practices necessary to ensure that reliability and quality are cost effectively engineered into our systems. Somehow, the engineering discipline of reliability has been reduced to a minor factor associated with total ownership cost, instead of a fundamental characteristic of our systems. Availability considerations have faded into the background and many of our experienced acquisition professionals are no longer in the workforce. Recognizing the need to act at the enterprise level, the direction taken by the Office of the Secretary of Defense (OSD) Acquisition, Technology, and Logistics (AT&L) leadership and the Joint Requirements Oversight Council (JROC) was based on understanding the integrated acquisition and sustainment environment as it exists today, and was intended to use the primary management structures, tools, and processes in place.

Today's program managers are provided very challenging cost and schedule goals and a small number of key performance parameters (KPPs) and key system attributes (KSAs) that must be met; and everything else may be traded off if necessary to meet those minimum requirements. In reality, that means that everything else MUST be traded when necessary to meet performance, cost, and schedule. In order to get reliable, available, affordable systems, then reliability, availability, and ownership cost had to become firm requirements instead of vague objectives. With the signing of the Joint Requirements Oversight Council Memorandum 161-06 in August 2006, the JROC established the requirements, endorsing the importance of achieving reliability and planning for sustainment as key to future warfighting capabilities. The approach taken in developing the KPP and KSAs was to establish firm requirements for what was to be measured, but provide maximum flexibility to the services and program sponsors to establish the specifics applicable to each system.

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Materiel availability—The capstone sustainment KPP

> Materiel Availability *is a measure of the percentage of the total inventory of a system operationally capable (ready for tasking) of performing an assigned mission at a given time, based on materiel condition. This can be expressed mathematically as (number of operational end items/total population).*
>
> Materiel Availability *also indicates the percentage of time that a system is operationally capable of performing an assigned mission and can be expressed as (uptime/(uptime + downtime)). (CJCSM 3170.01C)*

The introduction of a new term, *Materiel Availability*, has naturally raised questions and concerns, some of which will be addressed by providing the background and context for establishing the new KPP. As a metric, materiel availability provides insight into the usage of systems, but more importantly, requires that all of the major sustainment elements be considered, planned, and measured. The term *Materiel Availability* was deliberately chosen to emphasize that this metric is intended to support the management of the acquisition and materiel readiness processes whose function is to deliver capable, ready systems to the operational forces, as an input to operational readiness. Operational readiness is the concern of the operational forces and must still be measured and reported, and operational availability (A_o) no doubt will remain an important metric. Establishing and managing the materiel availability metric requires the consideration of all of the sustaining support that the acquisition and logistics professional must provide to sustain the capability being acquired, in addition to the reliability and maintainability characteristics of the system itself. The use of the term *Materiel Availability* was intended to highlight its difference from *Operational Availability*, although it can be argued that the definition of materiel availability is basically A_o at the highest level of the system, across the entire population. Since A_o is widely used and has become associated with very specific definitions in each service, selecting *Materiel Availability* further highlights that it is, by design, different from A_o as implemented across the services.

The numerical values for materiel availability will often differ from the values typically experienced for A_o, and may be significantly lower. The number itself provides some insight into the planned utility or capacity of the system, but the number itself is not as important as the discipline introduced by the need to plan and manage to objective values throughout the system. Achieving an arbitrary value for materiel availability is not the goal; rather the numerical value for availability should reflect the actual plans for operating and sustaining the system. For materiel availability, the entire population of the system must be accounted for, as does all time during the planned service life. Nonoperational units and time are included to provide a complete picture of the investment and sustainment required across the entire program life cycle.

The definition of *materiel availability* recognizes that in practical, concrete terms, the most direct way to measure readiness or availability in the field in many cases is to count how many end items are "up" each day. This approach works with some systems, but not all, and in order to establish the metric, analysis of downtime will still need to be conducted.

Generally, while the capstone metric is materiel availability, from the operator's viewpoint the starting point for establishing the metrics will be reliability, established as the new **Materiel Reliability** KSA. The intent of the KSA is to establish the reliability performance that is needed to make the system useful in its intended military context. This metric should be established with significant input from the operational users based on the planned employment of the system. Only the combatant commanders can really answer the question, "How reliable does the system need to be for it be useful in combat?" or "What probability of success must be achieved?"

> Materiel Reliability *is a measure of the probability that the system will perform without failure over a specific interval. Reliability must be sufficient to support the warfighting capability needed. (CJCSM 3170.01C)*

While the definition for *Materiel Reliability* in Chairman, Joint Chiefs of Staff Memorandum (CJCSM) 3170.01C goes on to discuss the use of mean time between failure, it does so in very general terms and was intended to allow the use of specific reliability metrics most appropriate to each system. For complex, multimission systems, it may be appropriate to establish more than one reliability metric or to use probability of mission success as the top level materiel reliability metric. In general, some form of mission reliability is most appropriate, although there may be cases in which logistics reliability would be recommended as the KSA. The selection and definition of the most appropriate metric for each system is left to the sponsor to recommend and support. It is critical to define the operating environments and mission profiles in which the system is intended to operate.

Left unbounded by cost, systems could achieve availability objectives by requiring excessive spares, maintenance, or other support elements and reliability gains could be pursued beyond the point of diminishing returns. Establishing **Ownership Cost** as a KSA is intended to add cost discipline beyond that provided by the current approach to total ownership cost and life cycle cost estimates.

> Ownership Cost *provides balance to the sustainment solution by ensuring that the operations and support (O&S) costs associated with materiel readiness are considered in making decisions. For consistency and to capitalize on existing efforts in this area, the Cost Analysis Improvement Group (CAIG) O&S Cost Estimating Structure will be used in support of this KSA. Fuel costs will be based on the fully burdened cost of fuel. Costs are to be included regardless of funding source. The KSA value should cover the planned lifecycle timeframe, consistent with the timeframe used in the Materiel Availability KPP. Sources of reference data, cost models, parametric cost estimating relationships, and other estimating techniques or tools must be identified in supporting analysis. Programs must plan for maintaining the traceability of costs incurred to estimates and must plan for testing and evaluation. The planned approach to monitoring, collecting, and validating operating and support cost data to supporting the KSA must be provided. (CJCSM 3170.01C)*

Since acquisition costs are intensely monitored already, the KSA is focused on O&S costs, and is intended to elevate management attention to O&S cost considerations. However, it was also recognized that the quality and completeness of O&S cost data available is less than that of acquisition cost data, and the connection between the O&S estimates and the eventual costs incurred is soft in some areas. Over the long term, this area will continue to mature, with the objective of eventually being able to rely on the O&S cost KSA values as the basis for planning and budgeting.

Only the cost elements most directly associated with materiel readiness are required, but program sponsors are free to add other cost elements if appropriate. For example, manpower costs are not required, but there are some systems for which manpower costs are the focus of significant program effort and should be included. The CAIG O&S Cost Estimating Structure is used so that the KSA does not create a new or different cost structure that would differ from that used for other program estimates.

Supporting analysis

Clearly all of the analysis required to establish the KPP and KSAs will not be included in the Capability Development Document (CDD) or Capability Production Document (CPD) with the established KPP and KSAs. To support the immediate requirements of programs submitting CDDs or CPDs for JROC approval, the Office of the Deputy Under Secretary of Defense for Logistics and Materiel Readiness and the Joint Staff J4 developed a "Guide to the Sustainment KPP" issued by J4 and available on the Joint Staff Knowledge Management and Decision Support system. The Guide defines the requirements for supporting analysis and the process by which recommendations for KPPs and KSAs are reviewed. While the Guide does not mandate specific formats or products, it does describe the criteria by which the analysis will be evaluated. A more definitive document is currently in development which will formalize and standardize the required analytical products. Currently titled the "DoD Reliability, Availability, Maintainability and Cost Rationale Report Handbook," it is intended to support three primary objectives:

1. Provide guidance in developing and documenting realistic sustainment KPP/KSA requirements and the related supporting rationale;
2. Provide guidance to the acquisition community to understand how the requirements must be measured and tested throughout the life cycle;
3. Describe the processes for OSD AT&L, the Joint Staff and other stakeholders to follow in interfacing with the Services and programs in developing sustainment requirements.

Using the processes established in the handbook will assist in assessing alternatives considered during the Analysis of Alternatives, and in articulating the requirements and the supporting rationale needed for the CDD and CPD. Subject matter experts from OSD AT&L, DOT&E and the Joint Staff have worked together to develop the handbook which was inspired by the "RAM Rationale Report" used in the past by the Army.

Test implications

The test community, particularly the OSD DOT&E leadership, has actively campaigned for renewed attention to setting and achieving performance goals during the product development process well in advance of the operational evaluation. It is certainly preferable for the user community to define the required availability and reliability that would constitute a useful (suitable) system than it is to leave that determination entirely subjective on the part of the

evaluator. A concern frequently voiced is that probabilistic measures such as availability and reliability are difficult to demonstrate during the operational test timeframe, and cost is almost impossible to verify directly. If we continued to view operational testing as a one time, pass/fail event as in the past, these concerns would be significant. Given the renewed leadership emphasis on using an integrated approach to testing intended to build confidence throughout the entire process leading to the operational test event, it certainly should be feasible to incrementally build up confidence in all of the sustainment elements.

Future steps

Within OSD, the new metrics have been endorsed by the Deputy Under Secretary of Defense for Logistics and Materiel Readiness for use even where they are not mandated as KPP or KSA values. Defense Acquisition Executive Summary reporting now includes sustainment, based on the new metrics discussed. Gradually, programs are developing benchmarks and assessing their status and contributing to our collective experience. Policy and guidance documents will address the metrics in their next revisions, and the status of these metrics is being added to major reviews. While the establishment of the mandatory Sustainment KPP is the cornerstone of our efforts, there is certainly additional work to be done to improve our ability to build in reliability and sustainment up front during the development stages of programs. Results from initial pilot programs exploring the relationship between funding and materiel readiness must be reviewed and action taken. There are improvements needed in collecting and analyzing system performance data across the enterprise, as well as in improving our O&S cost data collection and analysis. Shortfalls in our workforce skills are being identified and solutions are being developed. Finally, realistic approaches to testing the sustainment metrics will need to be established.

There is nothing more basic in the development of a weapon system than ensuring that when it is employed in combat, it will work when someone's life hangs in the balance. The progress made in restoring this discipline to the development process is significant, and will pay off in enhanced readiness and reduced cost over the life cycle of our weapon systems.

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